

## CLAIMS

- 1     1.     A conformable fuel cell, comprising:
  - 2             (A)     a membrane electrolyte intimately interfacing with a catalyst layer
  - 3             along each of the membrane's major surfaces being a catalyzed membrane
  - 4             electrolyte, having an anode aspect and a cathode aspect, and which catalyzed
  - 5             membrane electrolyte is conformable to a desired shape;
  - 6             (B)     diffusion layers sandwiching said catalyzed membrane electrolyte,
  - 7             said diffusion layers being comprised of materials that are conformable;
  - 8             (C)     flexible current collectors coupled with each of said anode aspect
  - 9             and said cathode aspect of said membrane electrolyte;
  - 10            (D)     fuel delivery means coupled with said anode aspect of said
  - 11            membrane electrolyte that delivers fuel substantially uniformly to said anode
  - 12            aspect while said fuel cell maintains said desired shape;
  - 13            (E)     electrical coupling disposed across said anode aspect and said
  - 14            cathode aspect and having means for connection to an application device being
  - 15            powered by said fuel cell.
- 1     2.     The conformable fuel cell as defined in claim 1 wherein said current collectors at
- 2     each of said anode aspect and said cathode aspect apply adequate compression effectively
- 3     over the active area of the membrane electrolyte.
- 1     3.     The conformable fuel cell as defined in claim 2 wherein said compression applied
- 2     to said active area is equal to or greater than about 100 psi.
- 1     4.     The conformable fuel cell as defined in claim 1 further comprising effective water
- 2     management from cathode to anode such that water management is achieved within the
- 3     fuel cell.

- 1     5.     The conformable fuel cell as defined in claim 1 wherein said fuel is substantially  
2           comprised of at least one of the following: a vapor fuel, a gel fuel, a liquid fuel  
3           and combinations thereof.
- 1     6.     The conformable fuel cell as defined in claim 1 further comprising a dedicated  
2           layer of material that substantially expands, thus imparting compression, upon at  
3           least one of the following: hydration, exposure to fuel, and exposure to heat.
- 1     7.     A conformable fuel cell system, comprising:  
2           (A)     a membrane electrode assembly, including:  
3                   (i)     a membrane electrolyte intimately interfacing with a  
4                   catalyst layer along each of the membrane's major surfaces being a  
5                   catalyzed membrane electrode, having an anode aspect and a cathode  
6                   aspect, and which catalyzed membrane electrolyte is conformable to a  
7                   desired shape;  
1                   (ii)     diffusion layers sandwiching said catalyzed membrane  
2                   electrolyte, said diffusion layers being comprised of materials that are  
3                   conformable;
- 4           (B)     fuel cell housing including a molded plastic frame that has  
5           been formed according to said desired shape that corresponds with a pre-selected  
6           body appendage or shape, whereby said fuel cell is thus conformable to said  
7           appendage or shape;
- 8           (C)     current collectors at each of said anode aspect and said  
9           cathode aspect and said current collectors being edge-clamped by said frame to  
10          apply compression effectively over the active area of the membrane electrolyte;
- 11          (D)     fuel delivery means coupled with said anode aspect of said  
12          membrane electrolyte that delivers fuel substantially uniformly to said anode  
13          aspect while said fuel cell maintains said desired shape; and

14                   (E)               electrical coupling disposed across said current collectors at  
15                   said anode aspect and said cathode aspect and having means for connection to an  
16                   application device being powered by said fuel cell.

1     8.     The conformable fuel cell as defined in claim 7 wherein said plastic frame is  
2     formed into said desired shape in an insert molding process.

1     9.     The conformable fuel cell system as defined in claim 7 wherein said compression  
2     applied to said active area is equal to or greater than about 100 psi.

1     10.    The conformable fuel cell system as defined in claim 7 further comprising:  
2           effective water management from cathode to anode such that water management  
3           is achieved within the fuel cell system.

1     11.    The conformable fuel cell system as defined in claim 7 wherein said fuel is  
2     substantially comprised of a vapor fuel, a gel fuel, a liquid fuel and combinations thereof.

1     12.    The conformable fuel cell system as defined in claim 7 wherein said conformable  
2     fuel cell system is shaped to conform to one of the following:

3           (A)     a body segment; and

4           (B)     a contoured wall of an application device; and

5           (C)     an exterior housing or an interior volume of an application device.

1     13.    The conformable fuel cell system as defined in claim 7 wherein said conformable  
2     fuel cell system is attached to an article of clothing mechanically.

1 14. The conformable fuel cell system as defined in claim 7 wherein fuel delivery is  
2 accomplished from a detachable conduit that connects to said anode aspect of the fuel  
3 cell.

1 15. A conformable fuel cell array, comprising:

2 (A) a plurality of individual fuel cells coupled in a communicating relationship  
3 such that the fuel cells combine to form an array that produces an overall power output;

4 (B) each individual fuel cell comprising a membrane electrolyte having an  
5 anode aspect and a cathode aspect, a fuel source, and current collectors that are coupled,  
6 and which coupling is connected to the other fuel cells in said array in such a manner that  
7 the electricity generated by each fuel cell is combined to produce said overall power  
8 output for the fuel cell; and

9 (C) means for coupling each individual fuel cell together in such a manner that  
10 the array of fuel cells is conformable to non-planar surfaces.

1 16. The conformable fuel cell array as defined in claim 15 wherein said current  
2 collectors at each of said anode aspect and said cathode aspect apply adequate  
3 compression effectively over the active area of the membrane electrolyte.

1 17. The conformable fuel cell array as defined in claim 15 wherein said compression  
2 applied to said active area is equal to or greater than about 100 psi.

1 18. The conformable fuel cell array as defined in claim 15 further comprising:  
2 effective water management from cathode to anode such that water management  
3 is achieved within the fuel cell array.

1 19. The conformable fuel cell array as defined in claim 15 wherein fuel from said fuel  
2 source is substantially comprised of at least one of the following: a vapor fuel, a gel fuel,  
3 a liquid fuel and combinations thereof.

1 20. A method of imparting compression to the components of a fuel cell having a  
2 catalyzed membrane electrolyte with two major surfaces, and an anode current collector  
3 and a cathode current collector, the method including the steps of:

4 molding a frame of the appropriate overall shape around the edge of the array and  
5 the edge of each individual cell, designed to apply such clamping power on the  
6 edges of the multilayered cells to result in target compression over the active area.

1 21. The method of imparting compression to components of a fuel cell as defined in  
2 claim 20 wherein said target compression is equal to or greater than about 100 psi.

3 22. A method of imparting compression to the components of a fuel cell having a  
4 catalyzed membrane electrolyte with two major surfaces, and an anode current collector  
5 and a cathode current collector, the method including the steps of:

6 pulling the anode current collector and the cathode current collector towards one  
7 another generally along the two major surfaces of the fuel cell using a connection  
8 element that can be placed under tension, such that compression is applied to the  
9 catalyzed membrane electrolyte.

10 23. The method of imparting compression as defined in claim 22, including the  
11 further step of employing as said compression element a nonconductive thread.

1 24. The method of imparting compression to a fuel cell as defined in claim 22,  
2 including the further step of providing a catalyzed membrane electrolyte that is

3 substantially comprised of a material that expands upon hydration such that when said  
4 membrane electrolyte is hydrated, the expanded material causes further compression  
5 within said fuel cell.

1 25. The method of imparting compression to a fuel cell as defined in claim 22  
2 including the further step of providing a dedicated layer of material that imparts  
3 compression to the active area of the catalyzed membrane when the dedicated layer  
4 undergoes expansion upon at least one of the following: hydration, exposure to fuel, and  
5 exposure to heat.